

# SPECIFICATION FOR APPROVAL

( ● ) Preliminary Specification

(   ) Final Specification

|       |                    |
|-------|--------------------|
| Title | 22.0" WXGA TFT LCD |
|-------|--------------------|

|       |             |
|-------|-------------|
| BUYER | Koshidatech |
| MODEL |             |

|          |                      |
|----------|----------------------|
| SUPPLIER | LG Display Co., Ltd. |
| *MODEL   | LC220WXE             |
| SUFFIX   | TBA1                 |

\*When you obtain standard approval,  
please use the above model name without suffix

| APPROVED BY | SIGNATURE | DATE |
|-------------|-----------|------|
| /           |           |      |
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Please return 1 copy for your confirmation with  
your signature and comments.

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## Product Specification

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# Product Specification

## Record of Revisions

[illegible]

## Product Specification

## 1. General Description

The LC220WXE is a Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Lamp (CCFL) backlight system. The matrix employs a-Si Thin Film Transistor as the active element.

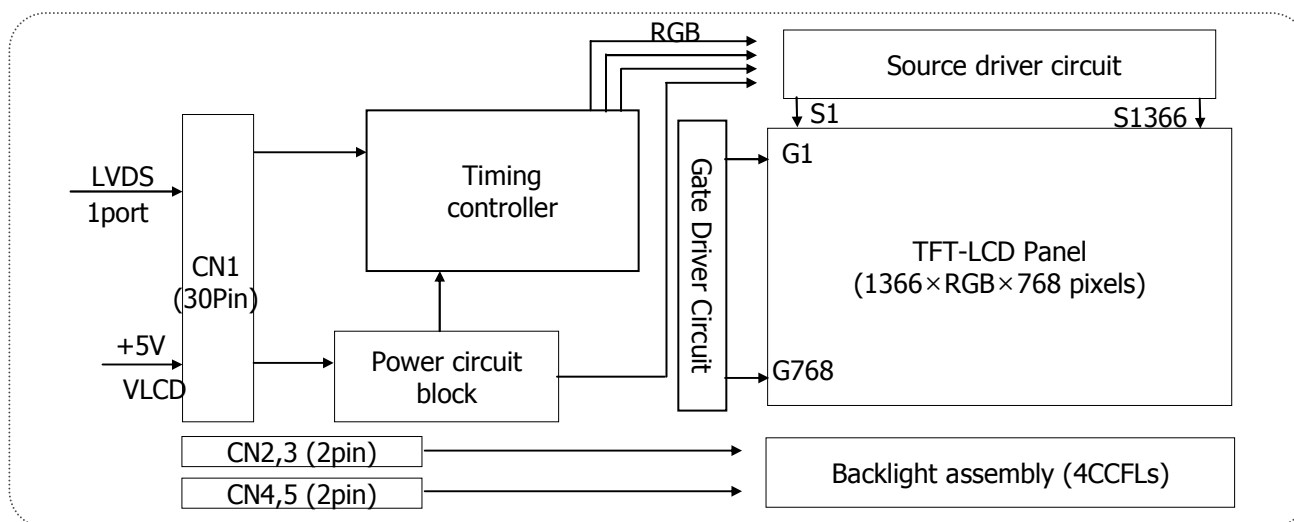
It is a transmissive type display operating in the normally white mode. It has a 21.6 inch diagonally measured active display area with WXGA resolution (768 vertical by 1366 horizontal pixel array)

Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes.

Gray scale or the luminance of the sub-pixel color is determined with a 8bit gray scale signal for each dot, thus presenting a palette of more than 16.7M(6bit+A-FRC) colors.

It has been designed to apply the 8-bit 1 port LVDS interface.

It is intended to support LCD TV, PCTV where thin thickness, wide viewing angle, low power are critical factors and fast response time are important.



## General Features

|                        |                                                                                   |
|------------------------|-----------------------------------------------------------------------------------|
| Active Screen Size     | 21.6 inches(548.6mm) diagonal                                                     |
| Outline Dimension      | 501.0 mm(H) x 297.0 mm(V) x 17.3 mm(D) (Typ.)                                     |
| Pixel Pitch            | 116.5 $\mu$ m x 349.5 $\mu$ m x RGB                                               |
| Pixel Format           | 1366 horiz. by 768 vert. pixels RGB stripe arrangement                            |
| Color Depth            | 8-bit(D), 16.7 M colors                                                           |
| Luminance, White       | 350 cd/m <sup>2</sup> (Center 1 point Typ.)                                       |
| Viewing Angle (CR>10)  | R/L 170(Typ.), U/D 160(Typ.)                                                      |
| Power Consumption      | Total <b>TBD</b> W (Typ.) (Logic= 2.20W, Back Light= <b>TBD</b> W @with Inverter) |
| Weight                 | 2300 g (Typ.) <b>[TBD]</b>                                                        |
| Display Operating Mode | Transmissive mode, Normally white                                                 |
| Surface Treatment      | Hard coating(3H), Anti-glare treatment of the front polarizer                     |

## Product Specification

## 2. Absolute Maximum Ratings

The following items are maximum values which, if exceeded, may cause faulty operation or damage to the LCD module.

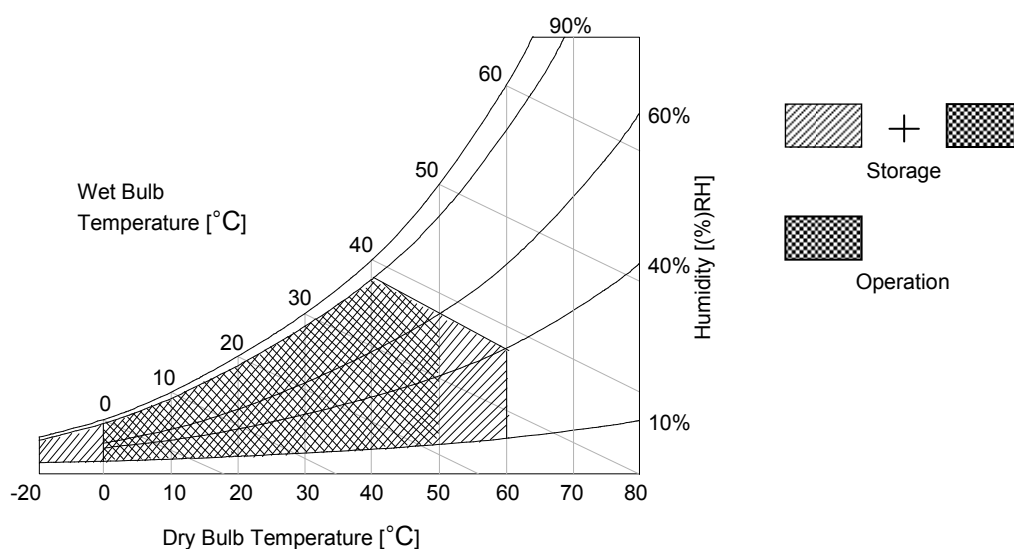
**Table 1. ABSOLUTE MAXIMUM RATINGS**

| Parameter                  |                              | Symbol           | Value |      | Unit    | Remark                                  |
|----------------------------|------------------------------|------------------|-------|------|---------|-----------------------------------------|
|                            |                              |                  | Min   | Max  |         |                                         |
| Power Input Voltage        | LCD circuit                  | V <sub>LCD</sub> | -0.3  | +6.0 | V [DC]  | at 25 ± 2 °C                            |
| B/L Input voltage          | Operating Voltage (one side) | V <sub>OP</sub>  | TBD   | TBD  | V[ RMS] | at 25 ± 2 °C<br>Burst Dimming Duty 100% |
| Operating Temperature      |                              | T <sub>OP</sub>  | 0     | +50  | °C      | Note 1                                  |
| Storage Temperature        |                              | T <sub>ST</sub>  | -20   | +60  | °C      |                                         |
| Operating Ambient Humidity |                              | H <sub>OP</sub>  | 10    | 90   | %RH     |                                         |
| Storage Humidity           |                              | H <sub>ST</sub>  | 10    | 90   | %RH     |                                         |

Note : 1. Temperature and relative humidity range are shown in the figure below.

Wet bulb temperature should be 39 °C Max. and no condensation of water.

2. Gravity mura can be guaranteed under 40 °C condition.



## Product Specification

### 3. Electrical Specifications

#### 3-1. Electrical Characteristics

It requires two power inputs. One is employed to power for the LCD circuit. The other is used for the CCFL backlight circuit.

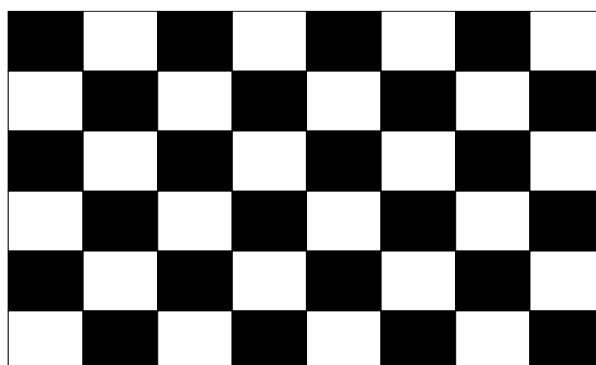
**Table 2. ELECTRICAL CHARACTERISTICS**

| Parameter           | Symbol | Value |           |           | Unit | Note |
|---------------------|--------|-------|-----------|-----------|------|------|
|                     |        | Min   | Typ       | Max       |      |      |
| MODULE :            |        |       |           |           |      |      |
| Power Input Voltage | VLCD   | 4.5   | 5.0       | 5.5       | VDC  |      |
| Power Input Current | ILCD   | -     | 440(TBD)  | 572(TBD)  | mA   | 1    |
|                     |        | -     | 530(TBD)  | 689(TBD)  | mA   | 2    |
| Power Consumption   | PLCD   | -     | 2.20(TBD) | 2.86(TBD) | Watt | 1    |
| Rush current        | IRUSH  | -     | -         | 3.0       | A    | 3    |

Note :

1. The specified current and power consumption are under the  $V_{LCD}=5.0V$ ,  $25 \pm 2^{\circ}C$ ,  $f_v=60Hz$  condition whereas mosaic pattern(8 x 6) is displayed and  $f_v$  is the frame frequency.
2. The current is specified at the maximum current pattern.
3. The duration of rush current is about 2ms and rising time of power Input is 0.5ms(min.).

White : 255 Gray  
Black : 0 Gray



Mosaic Pattern(8 x 6)

## Product Specification

Table 3. ELECTRICAL CHARACTERISTICS for IPB&amp; Lamp (Continue)

| Parameter                                                 |     | Symbol   | Values  |          |          | Unit              | Notes |
|-----------------------------------------------------------|-----|----------|---------|----------|----------|-------------------|-------|
|                                                           |     |          | Min     | Typ      | Max      |                   |       |
| Backlight Assembly :                                      |     |          |         |          |          |                   |       |
| Operating Voltage<br>(one side,fBL=62KHZ, IBL= 135mArms)) |     | VBL      | -       | 750(TBD) | -        | V <sub>RMS</sub>  | 1, 2  |
| Operating Current (one side)                              |     | IBL      | -       | 7.5      | -        | mA <sub>RMS</sub> | 1     |
| Established Starting<br>Voltage (one side)                | 0℃  | VS       | -       | -        | 1500     | V <sub>RMS</sub>  | 1, 3  |
|                                                           | 25℃ |          | -       | -        | 1240     |                   |       |
| Operating Frequency                                       |     | fBL      |         | 65       |          | KHz               | 4     |
| Striking Time                                             |     | S TIME   | -       | -        | 1.5      | sec               | 3     |
| Power Consumption                                         |     | PBL      |         | 28(TBD)  |          | Watt              | 6     |
| Burst Dimming Duty                                        |     | PWM duty | TBD     |          | 100      | %                 | 9     |
| Burst Dimming Frequency                                   |     | 1/T      | 98(TBD) | -        | 182(TBD) | Hz                | 9     |

| Parameter                               |       | Symbol | Values |     |         | Unit              | Notes |
|-----------------------------------------|-------|--------|--------|-----|---------|-------------------|-------|
|                                         |       |        | Min    | Typ | Max     |                   |       |
| Lamp : APPENDIX-V                       |       |        |        |     |         |                   |       |
| Lamp Voltage (one side)                 |       | VLAMP  |        | 800 |         | V <sub>RMS</sub>  | 2     |
| Lamp Current (one side)                 |       | ILAMP  |        | 7.5 |         | mA <sub>RMS</sub> |       |
| Discharge Stabilization Time            |       | TS     |        | 500 |         | Min               | 5     |
| Lamp Frequency                          |       | f LAMP |        | 65  |         | KHz               |       |
| Lamp Temperature                        |       | TLAMP  |        |     | 70(TBD) | °C                |       |
| Established Starting Voltage (one side) | 0 °C  | Vs     | -      | -   | 1500    | V <sub>RMS</sub>  | 3     |
|                                         | 25 °C | Vs     | -      | -   | 1240    |                   |       |
| Life Time                               |       |        | 50,000 | -   |         | Hrs               | 7     |

Notes : The design of the inverter must have specifications for the lamp in LCD Assembly.

The electrical characteristics of inverter are based on High-High Driving type.

The performance of the lamps in LCM, for example life time or brightness, is extremely influenced by the characteristics of the DC-AC inverter. So, all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.

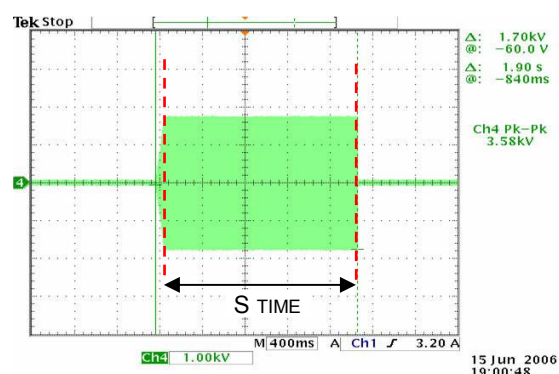
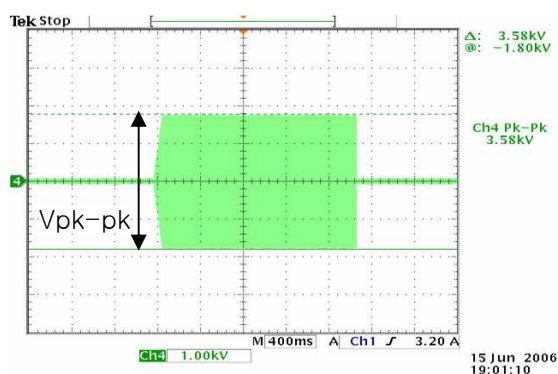
When you design or order the inverter, please make sure unwanted lighting caused by the mismatch of the lamp and the inverter (no lighting, flicker, etc) has never been occurred. When you confirm it, the LCD- Assembly should be operated in the same condition as installed in your instrument.

※ Do not attach a conductive tape to lamp connecting wire.

If you attach conductive tape to the lamp wire, not only luminance level can be lower than typical one but also inverter operate abnormally on account of leakage current which is generated between lamp wire and conductive tape.

- Specified values are defined for a Backlight Assembly.( IBL : 30mA lamp, 7.5mA/Lamp)
- Operating voltage is measured at  $25 \pm 2^{\circ}\text{C}$ (after 2hr.aging). The variance range for operating voltage is  $\pm 10\%$ .
- The established starting voltage [ Vs ] should be applied to the lamps for more than Striking time (S TIME) for start-up. Inverter open voltage must be more than established starting voltage. Otherwise, the lamps may not be turned on. The used lamp current is typical value.

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$$V_s = (V_{pk-pk}) / [2 \cdot \sqrt{2}]$$

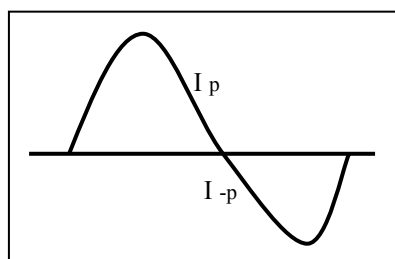
4. Lamp frequency may produce interference with horizontal synchronous frequency and as a result this may cause beat on the display. Therefore, lamp frequency shall be as away possible from the horizontal synchronous frequency and its harmonics range in order to prevent interference.
5. The brightness of the lamp after lighted for 5minutes is defined as 100%.  
 $T_s$  is the time required for the brightness of the center of the lamp to be not less than 95% at typical current.  
 The screen of LCD module may be partially dark by the time the brightness of lamp is stable after turn on.
6. Maximum level of power consumption is measured at initial turn on.  
 Typical level of power consumption is measured after 2hrs aging at  $25 \pm 2^\circ\text{C}$ .
7. The life time is determined as the time at which brightness of the lamp is 50% compared to that of initial value at the typical lamp current on condition of continuous operating at  $25 \pm 2^\circ\text{C}$ , based on duty 100%.
8. The output of the inverter must have symmetrical(negative and positive) voltage and current waveform (Unsymmetrical ratio is less than 10%). Please do not use the inverter which has not only unsymmetrical voltage and current but also spike wave.

Requirements for a system inverter design, which is intended to achieve better display performance, power efficiency and more reliable lamp characteristics.

It can help increase the lamp lifetime and reduce leakage current.

- a. The asymmetry rate of the inverter waveform should be less than 10%.
- b. The distortion rate of the waveform should be within  $\sqrt{2} \pm 10\%$ .

\* Inverter output waveform had better be more similar to ideal sine wave.



\* Asymmetry rate:

$$|I_p - I_{-p}| / I_{op} \times 100\%$$

\* Distortion rate

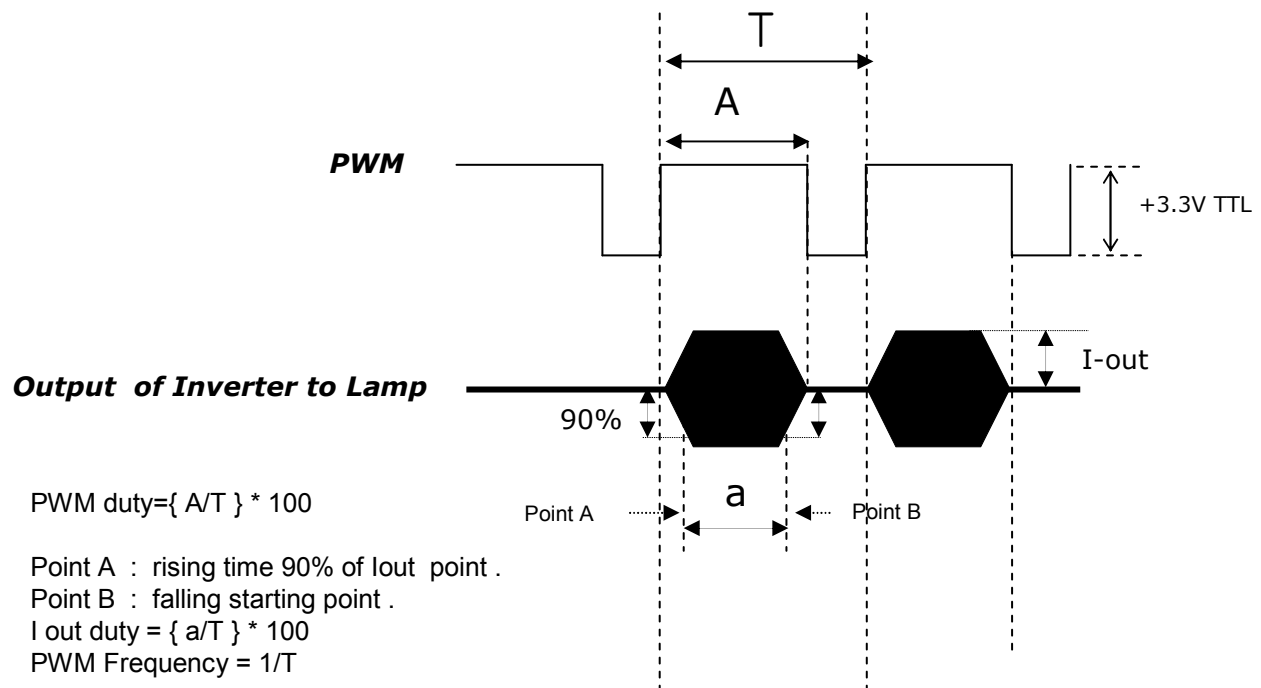
$$I_p \text{ (or } I_{-p}) / I_{op}$$



## Product Specification

## 9. The reference method of burst dimming duty ratio.

It is recommended to use synchronous V-sync frequency for prevent waterfall  
(Vsync x 2 =Burst Frequency)



- ※ We recommend not to be much different between PWM duty and Iout duty .
- ※ Dimming current output rising and falling time may produce humming and inverter trans' sound noise.
- ※ Burst dimming duty should be 100% for 1second after turn on
- ※ Equipment
  - Oscilloscope :TDS3054B(Tektronix)
  - Current Probe : P6022 AC (Tektronix)
  - High Voltage Probe: P5100(Tektronix)

10. The Cable between the backlight connector and its inverter power supply should be connected directly with a minimized length. The longer cable between the backlight and the inverter may cause the lower luminance of lamp and may require more higher starting voltage ( Vs ).

11. The operating current must be measured as near as backlight assembly input.

12. The operating current unbalance between left and right must be under typ  $\pm 10\%$ .

## Product Specification

### 3-2. Interface Connections

This LCD employs two kinds of interface connections, a 30 pin connector is used for the module electronics and 2Pin / 2Pin Connectors are used for the integral backlight system.

#### 3-2-1. LCD Module

- LCD Connector(CN1) : KDF71G-30S-1H(Hirose) or FI-X30SSL-HF(JAE)
- Mating Connector : : FI-X30C2L (Manufactured by JAE) or Equivalent

**Table 4. MODULE CONNECTOR(CN1) PIN CONFIGURATION**

| Pin No. | Symbol  | Description                           | Note |
|---------|---------|---------------------------------------|------|
| 1       | NC      | No Connection                         | 1    |
| 2       | PWM_OUT | Reference signal for inverter control | 2    |
| 3       | NC      | No Connection                         |      |
| 4       | GND     | Ground                                |      |
| 5       | RX0-    | LVDS Receiver Signal(-)               |      |
| 6       | RX0+    | LVDS Receiver Signal(+)               |      |
| 7       | GND     | Ground                                |      |
| 8       | RX1-    | LVDS Receiver Signal(-)               |      |
| 9       | RX1+    | LVDS Receiver Signal(+)               |      |
| 10      | GND     | Ground                                |      |
| 11      | RX2-    | LVDS Receiver Signal(-)               |      |
| 12      | RX2+    | LVDS Receiver Signal(+)               |      |
| 13      | GND     | Ground                                |      |
| 14      | RXCLK-  | LVDS Receiver Clock Signal(-)         |      |
| 15      | RXCLK+  | LVDS Receiver Clock Signal(+)         |      |
| 16      | GND     | Ground                                |      |
| 17      | RX3-    | LVDS Receiver Signal(-)               |      |
| 18      | RX3+    | LVDS Receiver Signal(+)               |      |
| 19      | GND     | Ground                                |      |
| 20      | NC      | No Connection                         |      |
| 21      | NC      | No Connection                         |      |
| 22      | NC      | No Connection                         |      |
| 23      | GND     | Ground                                |      |
| 24      | GND     | Ground                                |      |
| 25      | GND     | Ground                                |      |
| 26      | VLCD    | Power Supply +5.0V                    |      |
| 27      | VLCD    | Power Supply +5.0V                    |      |
| 28      | VLCD    | Power Supply +5.0V                    |      |
| 29      | VLCD    | Power Supply +5.0V                    |      |
| 30      | VLCD    | Power Supply +5.0V                    |      |

Notes: 1. Specific pin No. **#1** is used for "No signal detection" of system signal interface.

It should be GND for **NSB (No Signal Black)** during the system interface signal is not.

If this pin is "H", LCD Module displays **AGP (Auto Generation Pattern)**.

2. Specific pin No. **#2** (PWM\_OUT) is a reference signal for inverter control.

This PWM signal is synchronized with vertical frequency.

Its frequency is 3 times of vertical frequency, and its duty ratio is 50%.

If the system don't use this pin, do not connect.

3. All GND(ground) pins should be connected together to the LCD module's metal frame.

4. All  $V_{LCD}$  (power input) pins should be connected together.

5. All Input levels of LVDS signals are based on the **EIA 644** Standard.

Product Specification

3-2-2. Backlight Module

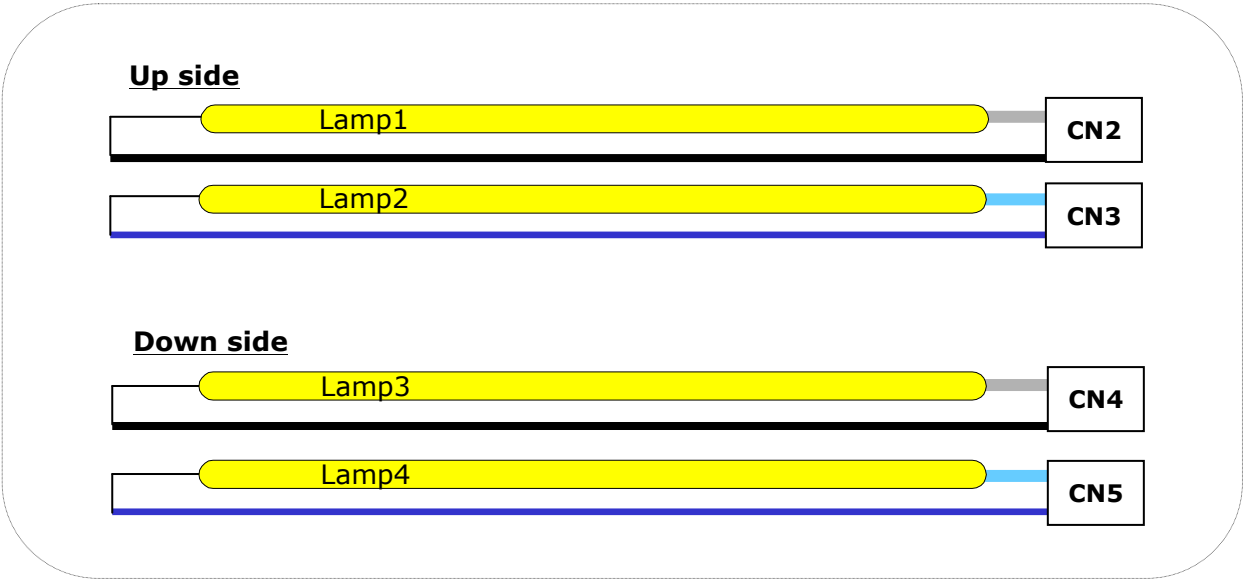
The backlight interface connector is a model 35001HS-02LD manufactured by YEONHO. The mating connector part number are 35001WR-02L(2pin) or equivalent. The pin configuration for the connector is shown in the table below.

Table 5. Backlight connector pin configuration(CN2,CN3,CN4,CN5)

| Pin | Symbol | Description           | Notes |
|-----|--------|-----------------------|-------|
| 1   | HV     | High Voltage for Lamp | 1     |
| 2   | LV     | Low Voltage for Lamp  | 2     |

Notes: 1. The high voltage power terminal is colored pink, sky blue.  
2. The low voltage pin color is white, black.

FIG. 5 Backlight connector diagram



## Product Specification

### 3-3. Signal Timing Specifications

Table 6 shows the signal timing required at the input of the LVDS transmitter. All of the interface signal timings should be satisfied with the following specification for normal operation.

**Table 6. TIMING TABLE for NTSC & PAL**

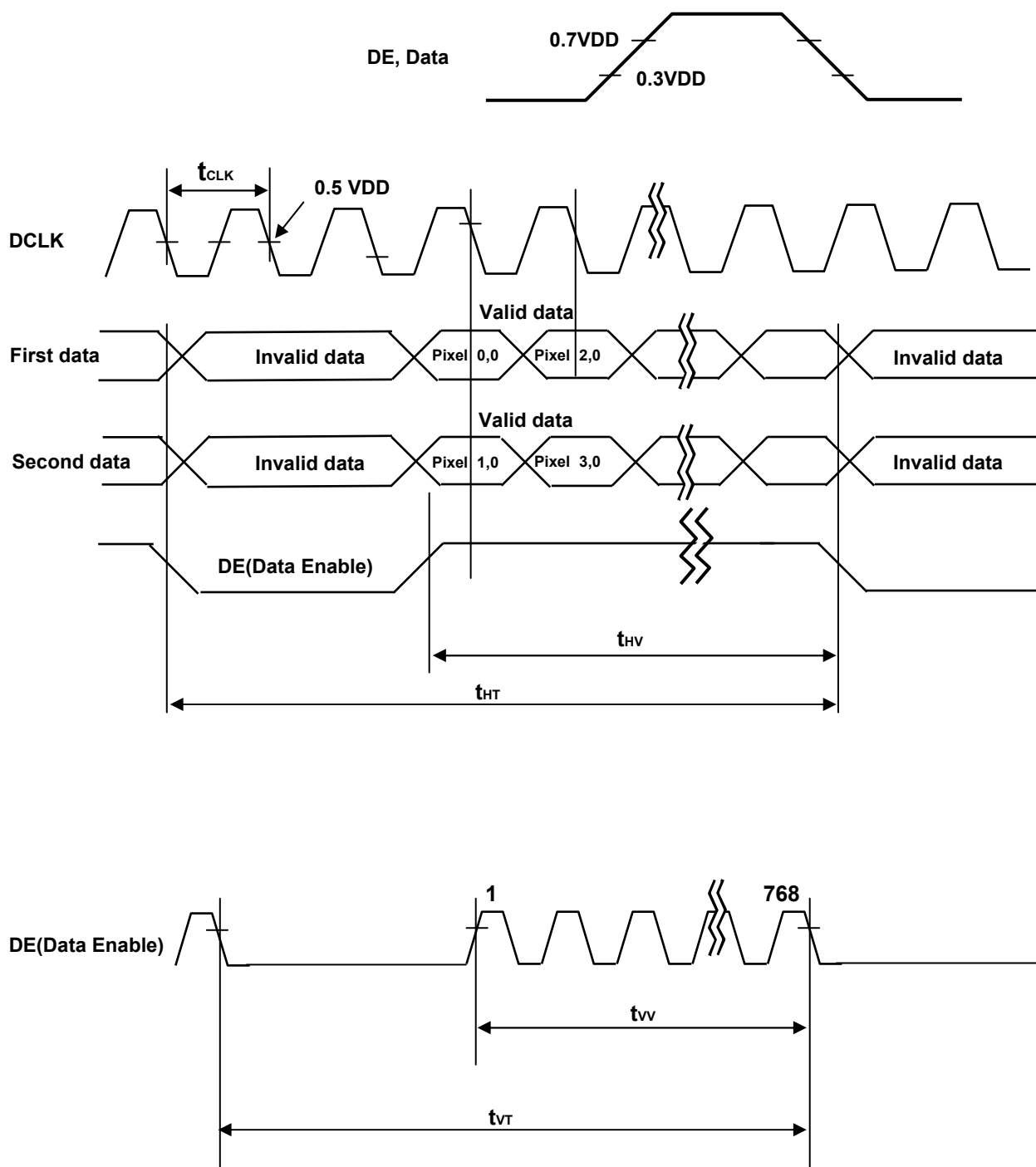
[ DE (Data Enable) Only ]

| ITEM  | Symbol                 |      | Min          | Typ          | Max            | Unit | Note                                         |
|-------|------------------------|------|--------------|--------------|----------------|------|----------------------------------------------|
| DCLK  | Period                 | tCLK | 12.5         | 13.8         | 15.8           | ns   |                                              |
|       | Frequency              | -    | 63           | 72.4         | 80             | MHz  |                                              |
| Hsync | Period                 | tHT  | 1456         | 1528         | 1920           | tCLK |                                              |
|       | Horizontal Valid       | tHV  | 1366         | 1366         | 1366           | tCLK |                                              |
|       | Horizontal Blank       | -    | tHP- tHV     | 162          | tHP- tHV       |      |                                              |
|       | Frequency              | fH   | 45           | 47.4         | 50             | KHz  |                                              |
|       | Width                  | tWH  | -            | 32           | -              | tCLK |                                              |
|       | Horizontal Back Porch  | tHBP | 24           | 48           | -              |      |                                              |
|       | Horizontal Front Porch | tHFP | 40           | 80           | -              |      |                                              |
| Vsync | Period                 | tVT  | 776<br>(894) | 790<br>(948) | 1063<br>(1008) | tHP  | Note 1)<br>NTSC : 57~63Hz<br>(PAL : 47~53Hz) |
|       | Vertical Valid         | tVV  | 768          | 768          | 768            | tHP  |                                              |
|       | Vertical Blank         | -    | tVP- tVV     | 22           | tVP- tVV       | tHP  |                                              |
|       | Frequency              | fV   | 57<br>(47)   | 60<br>(50)   | 63<br>(53)     | Hz   |                                              |
|       | Width                  | tWV  | -            | 5<br>(12)    | -              | tHP  |                                              |
|       | Vertical Back Porch    | tVBP | 5            | 15<br>(128)  | -              | Hz   |                                              |
|       | Vertical Front Porch   | tVFP | 1            | 2<br>(40)    | -              | tHP  |                                              |

Note :

1. The input of HSYNC & VSYNC signal does not have an effect on normal operation(DE Only Mode).  
If you use spread spectrum of EMI, add some additional clock to minimum value for clock margin.
2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rate and the horizontal frequency
3. Timing should be set based on clock frequency.

### 3-4. Signal Timing Waveforms



## Product Specification

## 3-5. Color Data Reference

The brightness of each primary color(red,green,blue) is based on the 8-bit gray scale data input for the color. The higher binary input, the brighter the color. Table 7 provides a reference for color versus data input.

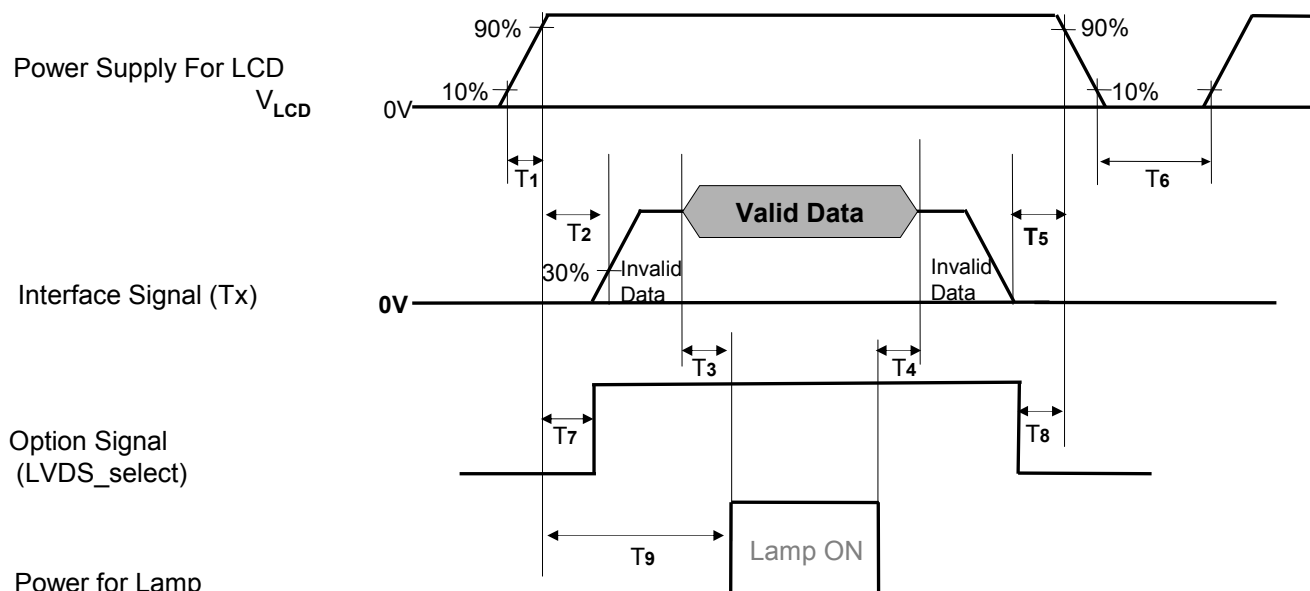
Table 7. COLOR DATA REFERENCE

| Color       |                     | Input Color Data |    |    |    |     |    |    |    |       |    |    |    |     |    |    |    |      |    |    |    |     |    |    |    |
|-------------|---------------------|------------------|----|----|----|-----|----|----|----|-------|----|----|----|-----|----|----|----|------|----|----|----|-----|----|----|----|
|             |                     | RED              |    |    |    |     |    |    |    | GREEN |    |    |    |     |    |    |    | BLUE |    |    |    |     |    |    |    |
|             |                     | MSB              |    |    |    | LSB |    |    |    | MSB   |    |    |    | LSB |    |    |    | MSB  |    |    |    | LSB |    |    |    |
|             |                     | R7               | R6 | R5 | R4 | R3  | R2 | R1 | R0 | G7    | G6 | G5 | G4 | G3  | G2 | G1 | G0 | B7   | B6 | B5 | B4 | B3  | B2 | B1 | B0 |
| Basic Color | Black               | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | Red (255)           | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | Green (255)         | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | Blue (255)          | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |
|             | Cyan                | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |
|             | Magenta             | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |
|             | Yellow              | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | White               | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |
| RED         | RED (000)    Dark   | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | RED (001)           | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 1  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | ...                 | ...              |    |    |    |     |    |    |    | ...   |    |    |    |     |    |    |    | ...  |    |    |    |     |    |    |    |
|             | RED (254)           | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | RED (255)           | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
| GREEN       | GREEN (000)    Dark | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | GREEN (001)         | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 1  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | ...                 | ...              |    |    |    |     |    |    |    | ...   |    |    |    |     |    |    |    | ...  |    |    |    |     |    |    |    |
|             | GREEN (254)         | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | GREEN (255)         | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
| BLUE        | BLUE (000)    Dark  | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | BLUE (001)          | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 1  | 0  |
|             | ...                 | ...              |    |    |    |     |    |    |    | ...   |    |    |    |     |    |    |    | ...  |    |    |    |     |    |    |    |
|             | BLUE (254)          | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 0  |
|             | BLUE (255)          | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |

## Product Specification

### 3-6. Power Sequence

#### 3-6-1. LCD Driving circuit



**Table 8. POWER SEQUENCE**

| Parameter | Value   |     |     | Unit | Notes |
|-----------|---------|-----|-----|------|-------|
|           | Min     | Typ | Max |      |       |
| T1        | 0.5     | -   | 20  | ms   |       |
| T2        | 0.5     | -   | -   | ms   | 4, 5  |
| T3        | 200     | -   | -   | ms   | 3     |
| T4        | 200     | -   | -   | ms   | 3     |
| T5        | 0       | -   | -   | ms   |       |
| T6        | 2.0     | -   | -   | s    | 5     |
| T7        | 0.5     | -   | T2  | ms   | 4     |
| T8        | 0       | -   | -   | ms   | 4     |
| T9        | T2 + T3 | -   | 5   | s    |       |

- Note :
1. Please avoid floating state of interface signal at invalid period.
  2. When the interface signal is invalid, be sure to pull down the power supply  $V_{LCD}$  to 0V.
  3. The T3/T4 is recommended value, the case when failed to meet a minimum specification, abnormal display would be shown. There is no reliability problem.
  4. If the on time of signals (Interface signal and Option signals) precedes the on time of Power ( $V_{LCD}$ ), it will be happened abnormal display.
  5. T6 should be measured after the Module has been fully discharged between power off and on period.

## Product Specification

#### 4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable in a dark environment at  $25 \pm 2^\circ\text{C}$ . The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of  $\Phi$  and  $\theta$  equal to  $0^\circ$ .

FIG. 1 shows additional information concerning the measurement equipment and method.

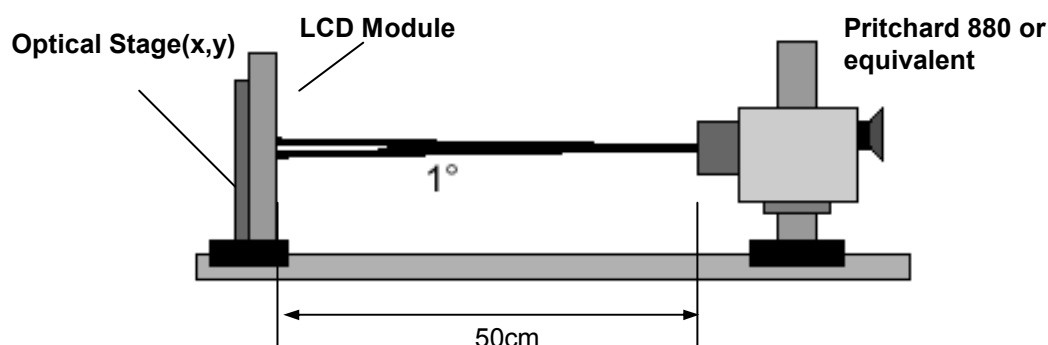


FIG. 1 Optical Characteristic Measurement Equipment and Method

Table 11. OPTICAL CHARACTERISTICS

$T_a = 25 \pm 2^\circ\text{C}$ ,  $V_{\text{LCD}} = 5.0\text{V}$ ,  $f_v = 60\text{Hz}$ ,  $D_{\text{clk}} = 72.4\text{MHz}$

| Parameter                   |                                   | Symbol                     | Value        |       |              | Unit            | Note |
|-----------------------------|-----------------------------------|----------------------------|--------------|-------|--------------|-----------------|------|
|                             |                                   |                            | Min          | Typ   | Max          |                 |      |
| Contrast Ratio              |                                   | CR                         | 600          | 800   | -            |                 | 1    |
| Surface Luminance, white    |                                   | $L_{\text{WH}}$            | 280          | 350   | -            | $\text{cd/m}^2$ | 2    |
| Luminance Variation         |                                   | $\delta_{\text{WHITE}}$ 5P |              |       | 1.3          |                 | 3    |
| Response Time               | Rising time                       | $T_{\text{R}}$             |              | 1.1   | 1.7          | ms              | 4    |
|                             | Falling time                      | $T_{\text{D}}$             |              | 3.9   | 5.9          |                 |      |
| Color Coordinates [CIE1931] | RED                               | $R_x$                      | Typ<br>-0.03 | TBD   | Typ<br>+0.03 |                 |      |
|                             |                                   | $R_y$                      |              | TBD   |              |                 |      |
|                             | GREEN                             | $G_x$                      |              | TBD   |              |                 |      |
|                             |                                   | $G_y$                      |              | TBD   |              |                 |      |
|                             | BLUE                              | $B_x$                      |              | TBD   |              |                 |      |
|                             |                                   | $B_y$                      |              | TBD   |              |                 |      |
|                             | WHITE                             | $W_x$                      |              | 0.289 |              |                 |      |
|                             |                                   | $W_y$                      |              | 0.293 |              |                 |      |
| Viewing Angle (CR>10)       |                                   |                            |              |       |              |                 |      |
|                             | x axis, right( $\phi=0^\circ$ )   | $\theta_r$                 | -            | 85    | -            | degree          | 5    |
|                             | x axis, left ( $\phi=180^\circ$ ) | $\theta_l$                 | -            | 85    | -            |                 |      |
|                             | y axis, up ( $\phi=90^\circ$ )    | $\theta_u$                 | -            | 75    | -            |                 |      |
|                             | y axis, down ( $\phi=270^\circ$ ) | $\theta_d$                 | -            | 85    | -            |                 |      |
| Gray Scale                  |                                   |                            | -            | 2.2   | -            |                 | 6    |



## Product Specification

Notes :1. Contrast Ratio(CR) is defined mathematically as :

$$CRn = \frac{\text{Surface Luminance at all white pixels}}{\text{Surface Luminance at all black pixels}}$$

It is measured at center 1-point.

2. Surface luminance are determined after the unit has been 'ON' and 1Hour after lighting the backlight in a dark environment at  $25 \pm 2^\circ\text{C}$ . Surface luminance is the luminance value at center 1-point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see the FIG. 2.
3. The variation in surface luminance ,  $\delta$  WHITE is defined as :  
 $\delta \text{ WHITE}(5P) = \text{Maximum}(L_{on1}, L_{on2}, L_{on3}, L_{on4}, L_{on5}) / \text{Minimum}(L_{on1}, L_{on2}, L_{on3}, L_{on4}, L_{on5})$   
 Where  $L_{on1}$  to  $L_{on5}$  are the luminance with all pixels displaying white at 5 locations .  
 For more information, see the FIG. 2.
4. Response time is the time required for the display to transition from black to white (Decay time,  $Tr_D$ ) and from white to black (Rise Time,  $Tr_R$ ). For additional information see the FIG. 3.
5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD module surface. For more information, see the FIG. 4.
6. Gray scale specification  
 Gamma Value is approximately 2.2. For more information, see the Table 10.

**Table 10. GRAY SCALE SPECIFICATION**

| Gray Level | Luminance [%] (Typ.) |
|------------|----------------------|
| L0         | 0.13                 |
| L15        | 0.27                 |
| L31        | 1.04                 |
| L47        | 2.49                 |
| L63        | 4.68                 |
| L79        | 7.66                 |
| L95        | 11.5                 |
| L111       | 16.1                 |
| L127       | 21.6                 |
| L143       | 28.1                 |
| L159       | 35.4                 |
| L175       | 43.7                 |
| L191       | 53.0                 |
| L207       | 63.2                 |
| L223       | 74.5                 |
| L239       | 86.7                 |
| L255       | 100                  |

Product Specification

Measuring point for surface luminance & measuring point for luminance variation.

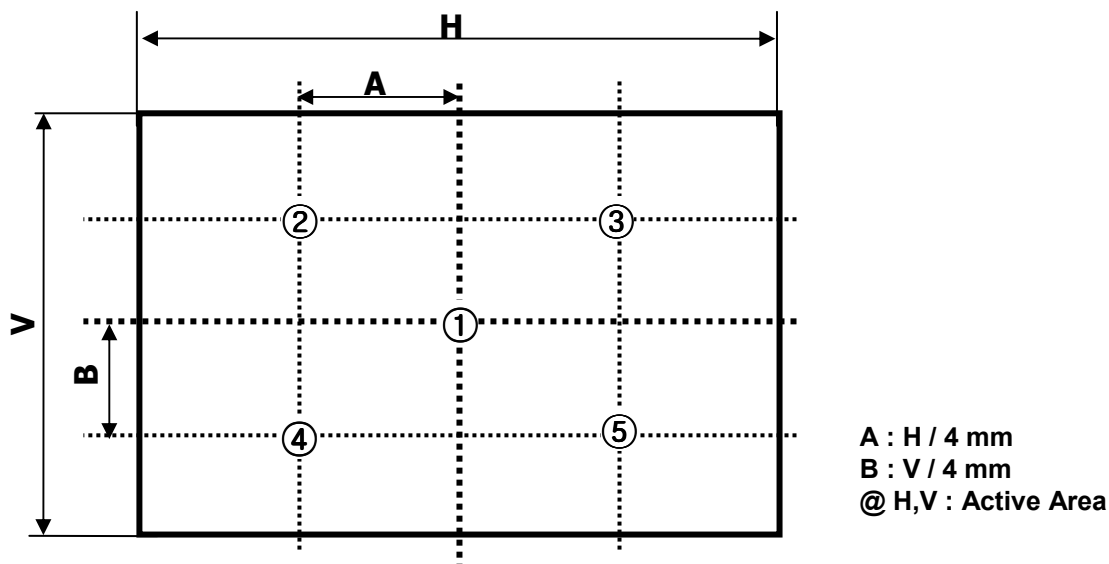


FIG. 2 5 Points for Luminance Measure

Response time is defined as the following figure and shall be measured by switching the input signal for each gray to gray.

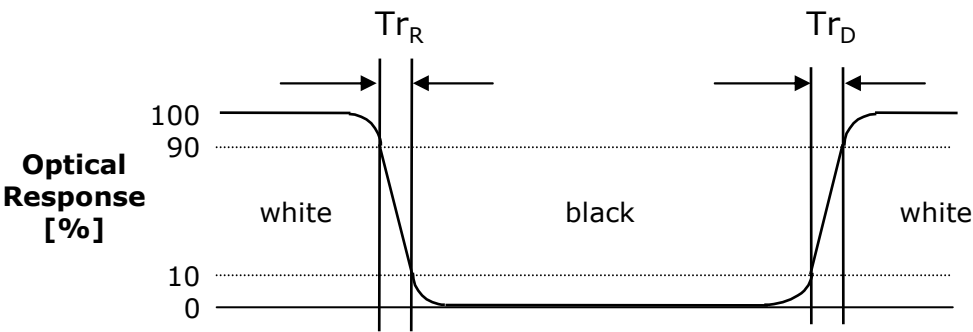


FIG. 3 Response Time

## Product Specification

Dimension of viewing angle range

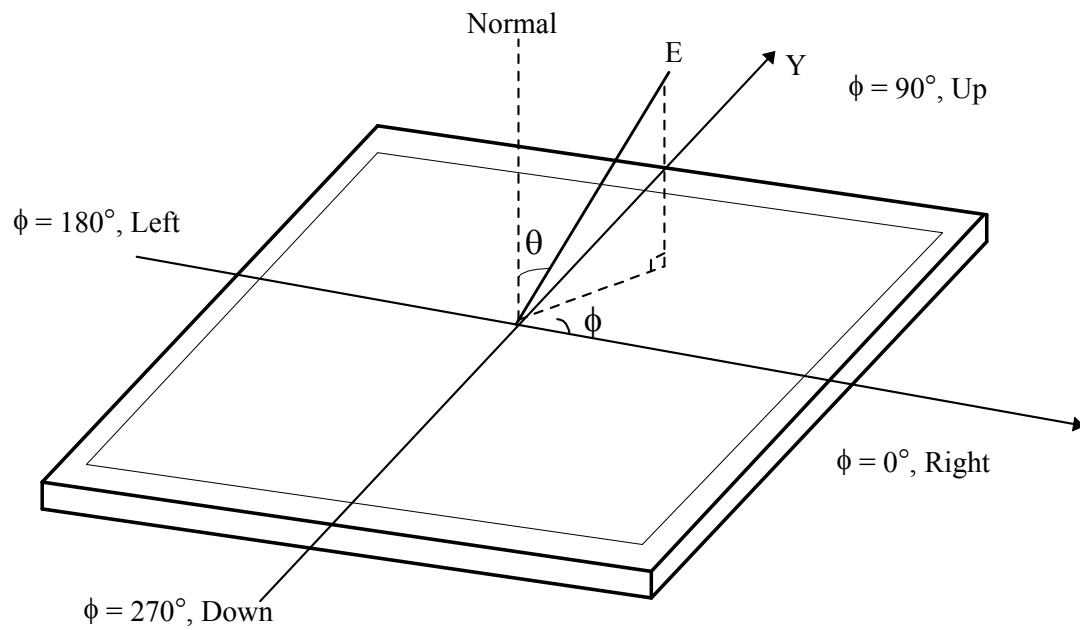


FIG. 4 Viewing Angle

## Product Specification

## 5. Mechanical Characteristics

Table 11 provides general mechanical characteristics.

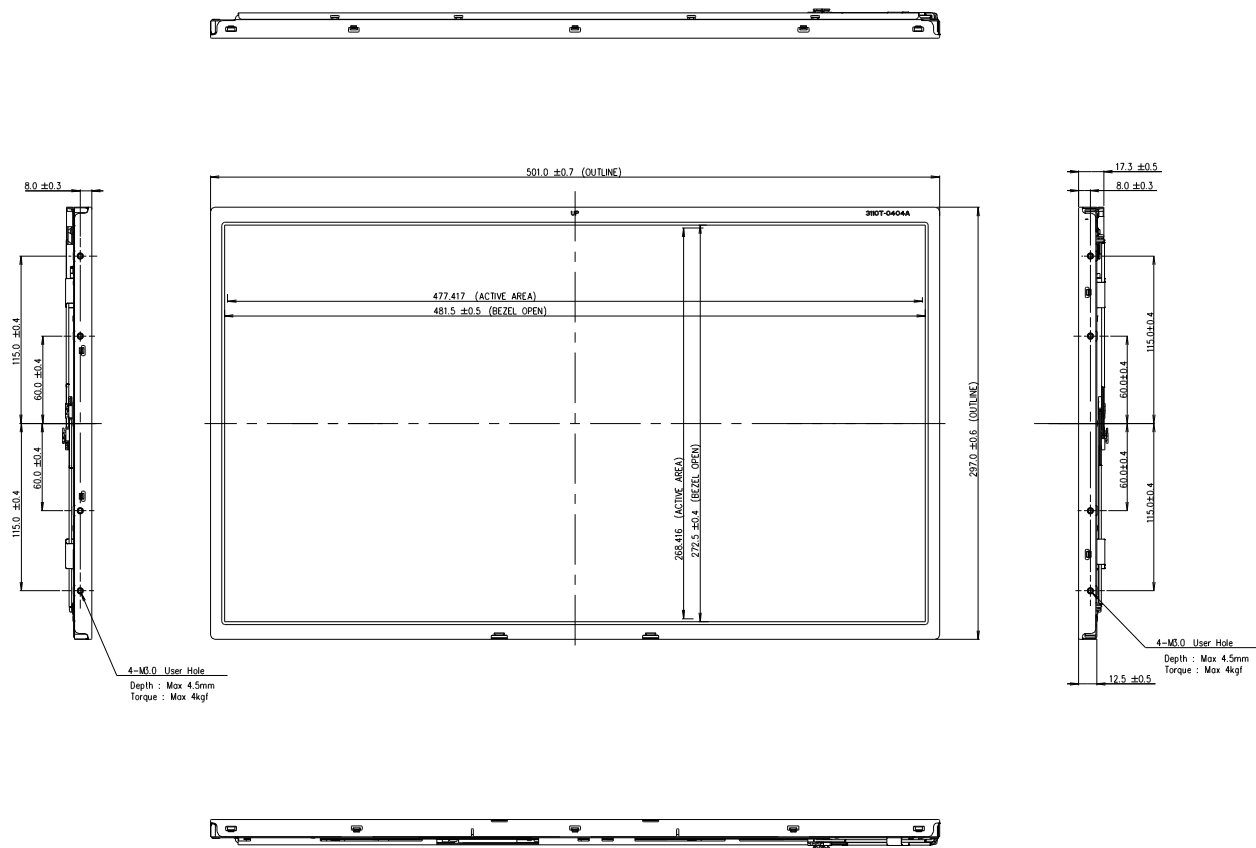
**Table 11. MECHANICAL CHARACTERISTICS**

| Item                | Value                                       |            |
|---------------------|---------------------------------------------|------------|
| Outline Dimension   | Horizontal                                  | 501.0 mm   |
|                     | Vertical                                    | 297.0 mm   |
|                     | Depth                                       | 17.3 mm    |
| Bezel Area          | Horizontal                                  | 481.5 mm   |
|                     | Vertical                                    | 272.5 mm   |
| Active Display Area | Horizontal                                  | 477.417 mm |
|                     | Vertical                                    | 268.416 mm |
| Weight              | 2,300 g (Typ.) , 2500 g (Max.) <b>[TBD]</b> |            |

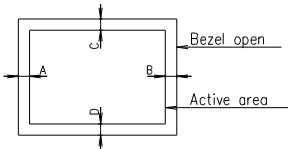
Note : Please refer to a mechanic drawing in terms of tolerance at the next page.

Product Specification

<FRONT VIEW>



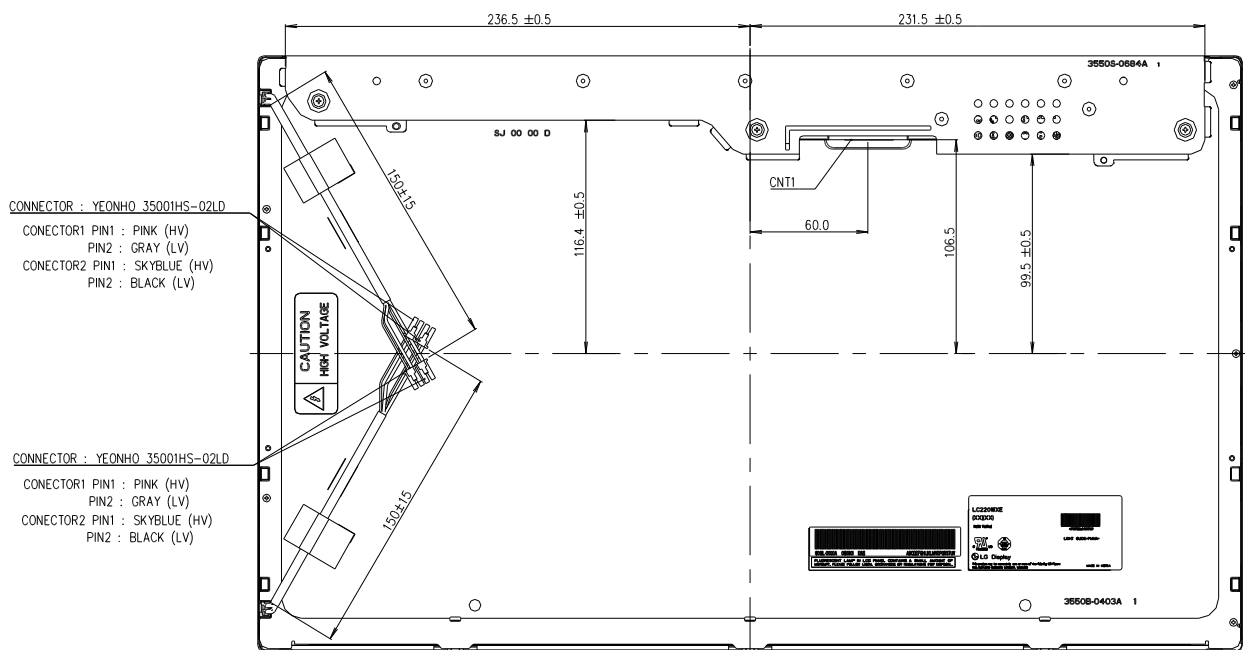
- NOTES
1. Unspecified tolerances are to be  $\pm 0.5\text{mm}$ .
  2. This drawing is only preliminary data and can be changed without notice.
  3. Tilt and partial disposition tolerance of display area is as following.
    - (1) X-Direction : IA-BI 1.0mm
    - (2) Y-Direction : IC-DI 1.0mm



4. Backlight wires and contraction tubes are excluded from outline dimension.
5. Do not wind conductive tape around the backlight wires.

## Product Specification

<REAR VIEW>



## Product Specification

## 6. Reliability

**Table 13. ENVIRONMENT TEST CONDITION**

| No. | Test Item                                | Condition                                                                                                                      |
|-----|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| 1   | High temperature storage test            | Ta= 60°C 240h                                                                                                                  |
| 2   | Low temperature storage test             | Ta= -20°C 240h                                                                                                                 |
| 3   | High temperature operation test          | Ta= 50°C 50%RH 240h                                                                                                            |
| 4   | Low temperature operation test           | Ta= 0°C 240h                                                                                                                   |
| 5   | Vibration test<br>(non-operating)        | Wave form : random<br>Vibration level : 1.0Grms<br>Bandwidth : 10-300Hz<br>Duration : X,Y,Z, 20 min<br>One time each direction |
| 6   | Shock test<br>(non-operating)            | Shock level : 120Grms<br>Waveform : half sine wave, 2ms<br>Direction : ± X, ± Y, ± Z<br>One time each direction                |
| 7   | Humidity condition Operation             | Ta= 40 °C ,90%RH                                                                                                               |
| 8   | Altitude operating<br>storage / shipment | 0 - 15,000 ft<br>0 - 40,000 ft                                                                                                 |

Note : Before and after Reliability test, LCM should be operated with normal function.

## Product Specification

## 7. International Standards

### 7-1. Safety

- a) UL 60065, 7<sup>th</sup> Edition, dated June 30, 2003, Underwriters Laboratories, Inc., Standard for Audio, Video and Similar Electronic Apparatus.
- b) CAN/CSA C22.2, No. 60065:03, Canadian Standards Association, Standard for Audio, Video and Similar Electronic Apparatus.
- c) IEC60065:2001, 7<sup>th</sup> Edition CB-scheme and EN 60065:2002, Safety requirements for Audio, Video and Similar Electronic Apparatus..

### 7-2. EMC

- a) ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHz to 40GHz. "American National Standards Institute(ANSI), 1992
- b) CISPR13 "Limits and Methods of Measurement of Radio interference characteristics of Sound and Television broadcast receivers and associated equipment"  
CISPR22 "Limits and Methods of Measurement of Radio interference characteristics of Information Technology Equipment" International Special Committee on Radio Interference.
- c) EN55013 "Limits and Methods of Measurement of Radio interference characteristics of Sound and Television broadcast receivers and associated equipment"  
EN55022 "Limits and Methods of Measurement of Radio interference characteristics of Information Technology Equipment" European Committee for Electro Technical Standardization (CENELEC), 1988(Including A1:2000)



## Product Specification

**8. Packing****8-1. Designation of Lot Mark**

## a) Lot Mark

|   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

A,B,C : SIZE(INCH)

D : YEAR

F : PANEL CODE

H : ASSEMBLY CODE

E : MONTH

G : FACTORY CODE

I,J,K,L,M : SERIAL NO.

## Note

## 1. YEAR

|      |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|------|
| Year | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| Mark | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 0    |

## 2. MONTH

|       |     |     |     |     |     |     |     |     |     |     |     |     |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Mark  | 1   | 2   | 4   | 4   | 5   | 6   | 7   | 8   | 9   | A   | B   | C   |

## b) Location of Lot Mark

Serial NO. is printed on the label. The label is attached to the backside of the LCD module.  
This is subject to change without prior notice.

**8-2. Packing Form**

a) Package quantity in one Pallet : 7 pcs

b) Pallet Size : 550 mm X 314 mm X 402 mm.

## Product Specification

**9. Precautions**

Please pay attention to the followings when you use this TFT LCD module.

**9-1. Mounting Precautions**

- (1) You must mount a module using specified mounting holes (Details refer to the drawings).
- (2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth. (Some cosmetics are detrimental to the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.

**9-2. Operating Precautions**

- (1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :  
 $V = \pm 200\text{mV}$  (Over and under shoot voltage)
- (2) Response time depends on the temperature. (In lower temperature, it becomes longer.)
- (3) Brightness depends on the temperature. (In lower temperature, it becomes lower.)  
 And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer
- (4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can't be operated its full characteristics perfectly.
- (8) A screw which is fastened up the steels should be a machine screw.  
 (if not, it can cause conductive particles and deal LCM a fatal blow)
- (9) Please do not set LCD on its edge.
- (10) Partial darkness may happen during 3~5 minutes when LCM is operated initially in condition that luminance is under 40% at low temperature (under 5°C). This phenomenon which disappears naturally after 3~5 minutes is not a problem about reliability but LCD characteristic

### 9-3. Electrostatic Discharge Control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

### 9-4. Precautions for Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

### 9-5. Storage

When storing modules as spares for a long time, the following precautions are necessary.

- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object.  
It is recommended that they be stored in the container in which they were shipped.

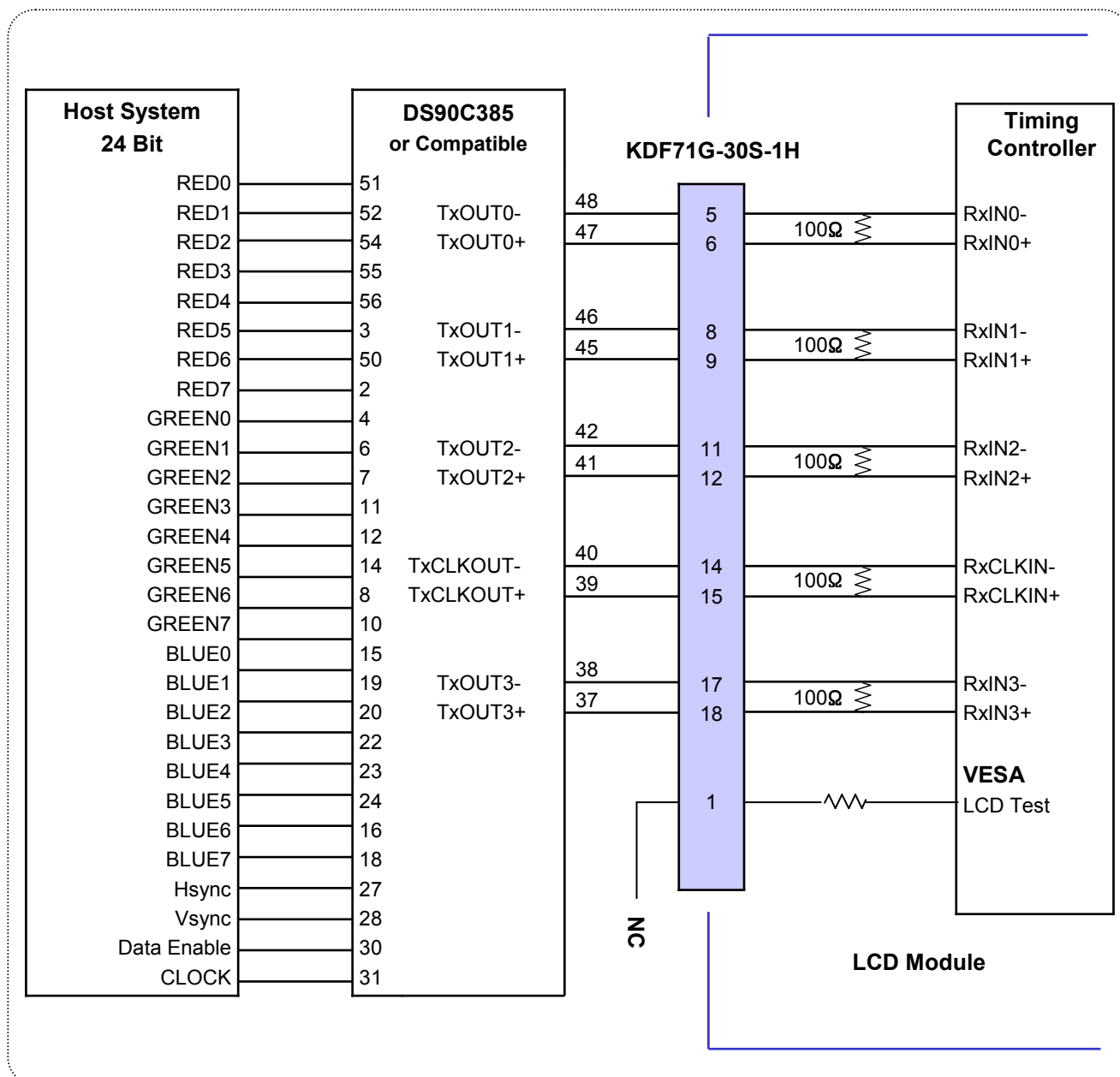
### 9-6. Handling Precautions for Protection Film

- (1) The protection film is attached to the bezel with a small masking tape.  
When the protection film is peeled off, static electricity is generated between the film and polarizer.  
This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- (2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
- (3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

## Product Specification

## # APPENDIX- I

## ■ Required signal assignment for Flat Link Transmitter



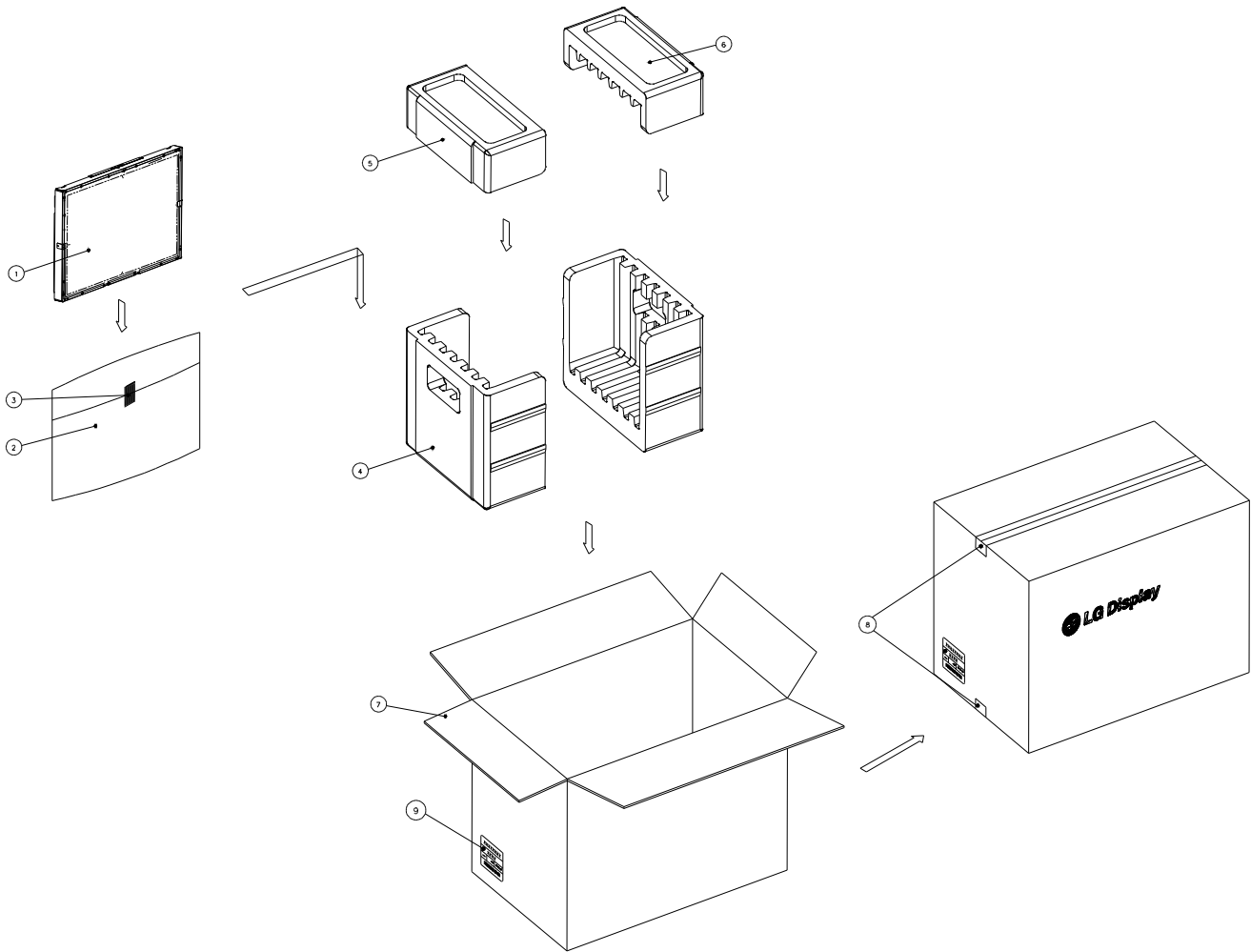
## Notes:

1. The LCD module uses a 100 ohm( $\Omega$ ) resistor between positive and negative lines of each receiver input.
2. Refer to LVDS transmitter data sheet for detail descriptions. (DS90C385 or Compatible)
3. '7' means MSB and '0' means LSB at R,G,B pixel data.

Product Specification

# APPENDIX- II

■ LC220WXE-TBA1-Packing AssY

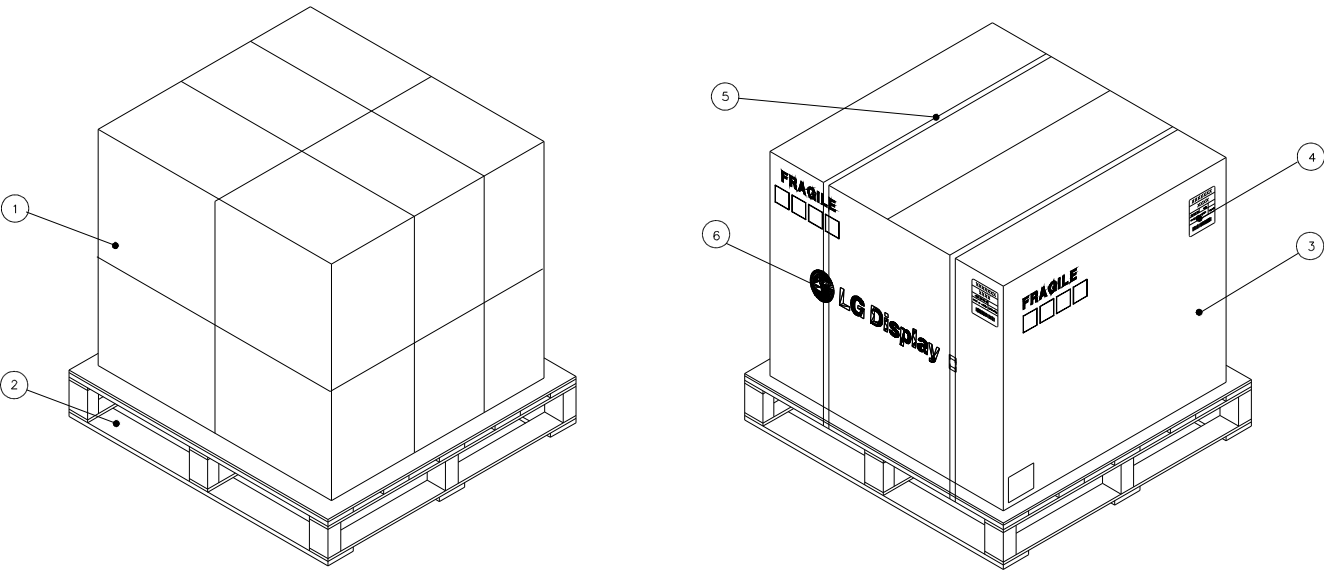


| NO. | DESCRIPTION  | MATERIAL |
|-----|--------------|----------|
| 1   | LCD Module   |          |
| 2   | BAG          | PE       |
| 3   | TAPE         | MASKING  |
| 4   | Packing(B)   | EPS      |
| 5/6 | Packing(L/R) | EPS      |
| 7   | BOX          | SWR4     |
| 8   | TAPE         | OPP      |

Product Specification

# APPENDIX- III

■ LC220WXE-TBA1-Pallet AssY

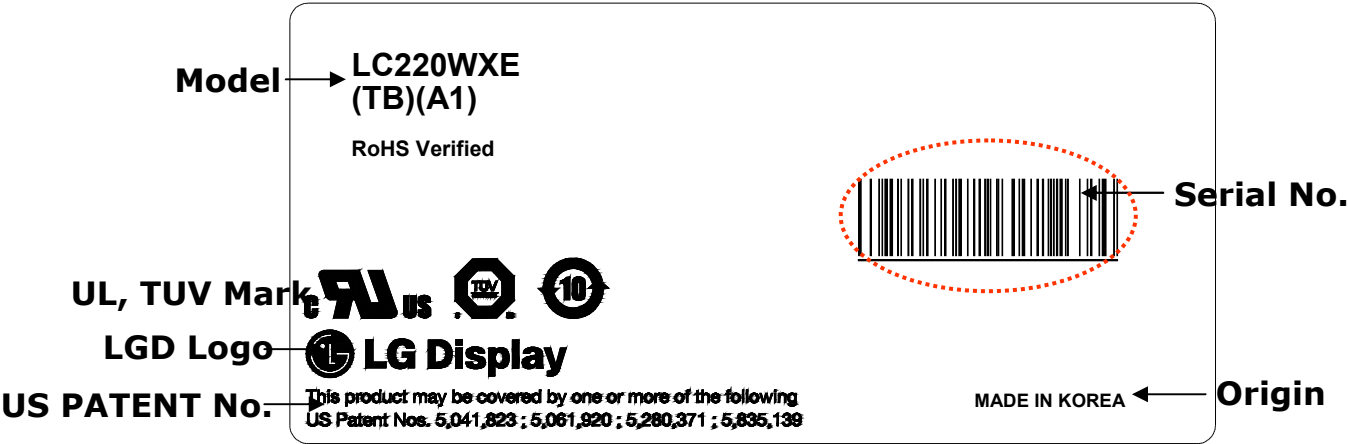


| NO. | DESCRIPTION    | MATERIAL   |
|-----|----------------|------------|
| 1   | PACKING ASS'Y  |            |
| 2   | PALLET         | PAPER      |
| 3   | ANGLE, PACKING | SWR4       |
| 4   | LABEL          | YUPO PAPER |
| 5   | BAND           | PP         |
| 6   | BAND, CLIP     | STEEL      |

Product Specification

# APPENDIX- IV

■ LCM Label



Product Specification

# APPENDIX- V

■ Box Label

|                                                                                   |           |               |
|-----------------------------------------------------------------------------------|-----------|---------------|
| LC220WXE                                                                          |           |               |
| TBA1                                                                              |           |               |
| 7 PCS                                                                             | 001/01-01 |               |
| MADE IN KOREA                                                                     |           | RoHS Verified |
|  |           |               |

■ Pallet Label

|                                                                                                  |           |               |
|--------------------------------------------------------------------------------------------------|-----------|---------------|
| LC220WXE                                                                                         |           |               |
| TBA1                                                                                             |           |               |
| 84 PCS                                                                                           | 001/01-01 |               |
| MADE IN KOREA                                                                                    |           | RoHS Verified |
| <br>***** ** |           |               |

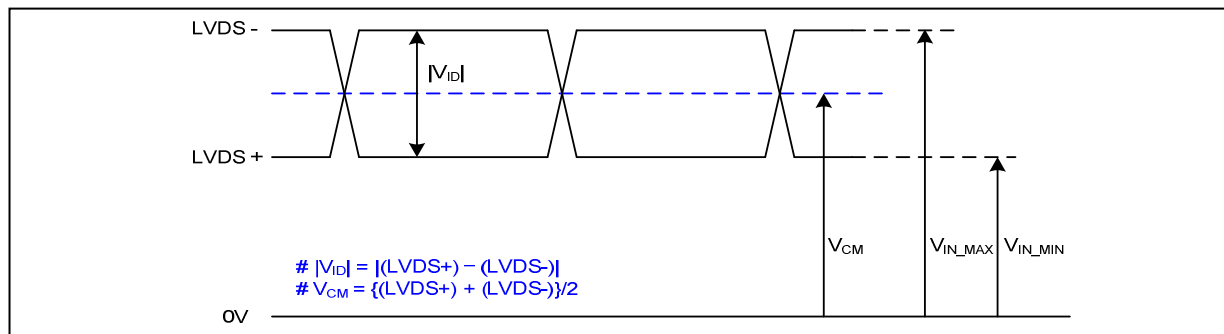


## Product Specification

## # APPENDIX- VI

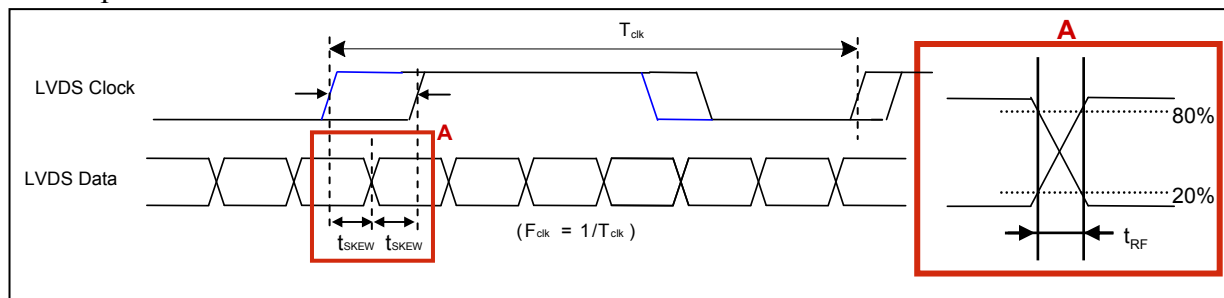
## LVDS Input characteristics

## 1. DC Specification



| Description                   | Symbol          | Min | Max | Unit | Notes |
|-------------------------------|-----------------|-----|-----|------|-------|
| LVDS Differential Voltage     | $ V_{ID} $      | 200 | 600 | mV   | -     |
| LVDS Common mode Voltage      | $V_{CM}$        | 1.1 | 1.5 | V    | -     |
| LVDS Input Voltage Range      | $V_{IN}$        | 0.7 | 1.8 | V    | -     |
| Change in common mode Voltage | $\Delta V_{CM}$ |     | 150 | mV   | -     |

## 2. AC Specification



| Description                         | Symbol     | Min | Max                     | Unit | Notes                                      |
|-------------------------------------|------------|-----|-------------------------|------|--------------------------------------------|
| LVDS Clock to Data Skew Margin      | $t_{SKEW}$ |     | 400                     | ps   | $78\text{MHz} > F_{clk} \geq 70\text{MHz}$ |
| LVDS Clock/DATA Rising/Falling time | $t_{RF}$   | 260 | $(0.3 \cdot T_{clk})/7$ | ps   | -                                          |

Note. All Input levels of LVDS signals are based on the EIA 644 Standard.

# APPENDIX- VII

LVDS Data-Mapping info. (8bit)

■ LVDS : Data-Mapping (VESA format)

